EXAMPLE 16

Sintered arc segment magnets as shown in FIG. 8 each having a length L_2 of 70 mm, a thickness T_2 of 2.5 mm, θ_2 of 40° and an inner diameter shown in Table 7 were produced in the same manner as in EXAMPLE 8 except for changing molding conditions and the sizes of a green bodies.

TABLE 7

Inner diameter of Arc Segment Magnet (mm)	H_{cJ} (kA/m)	H_{cJ} (kOe)	Orientation (%)
100	708.3	8.9	93.1
50	612.8	7.7	92.6
30	461.6	5.8	92.2
10	310.4	3.9	92.0

It is clear from Table 7 that the sintered arc segment magnets of EXAMPLE 16 had high orientation in a radial direction. They had squareness ratios Hk/iHc of more than 87.5% and iHc of more than 1.1 MA/m (14 kOe). Also, the arc segment magnets contained 0.14–0.16 weight % of oxygen, 0.05–0.06 weight % of carbon and 0.003–0.004 weight % of nitrogen.

Comparative Example 8

Though attempt was made to form arc-segment-shaped green bodies in the same manner as in EXAMPLE 16 except for using the slurry of COMPARATIVE EXAMPLE 4, cracking took place. Accordingly, sintered arc segment magnets could not be produced.

Though molding in a transverse magnetic field or in a radial magnetic field has been described in the above EXAMPLES, molding in a vertical magnetic field can also be used to produce arc segment magnets with better orientation $Br/4\pi I_{max}$ in anisotropy-providing direction than that of conventional arc segment magnets. Also, radial rings and arc segment magnets with improved radial orientation can be produced.

The present invention can produce arc-segment-shaped or ring-shaped R-T-B sintered magnets having low oxygen content and high density and orientation while preventing the cracking of green bodies, as compared with the methods for producing rare earth sintered magnets using conventional oil. Because shrinkage ratio and deformation can be suppressed in the course from green bodies to sintered bodies by the present invention, arc-segment-shaped or ring-shaped, sintered magnets with near-net shape and high orientation can be obtained.

What is claimed is:

1. A thin arc segment magnet having a thickness of 1–4 mm and made of a rare earth sintered magnet having a main component composition comprising 28–33 weight % of R and 0.8–1.5 weight % of B, the balance being substantially Fe, wherein R is at least one rare earth element including Y, and T is Fe or Fe and Co, said arc segment magnet having an oxygen content of 0.3 weight % or less based on the total weight of the magnet, a density of 7.56 g/cm^3 or more, a coercivity iHc of 1.1 MA/m (14 kOe) or more at room temperature, and an orientation $Br/4\pi I_{max}$ of 96% or more in an anisotropy-providing direction at room temperature.

2. The arc segment magnet according to claim 1, having parallel anisotropy.

3. The arc segment magnet according to claim 1, having an axial length of 40–100 mm.

4. The arc segment magnet according to claim 1, having a ratio I(105)/I(006) of 0.5–0.8, wherein I(105) represents the intensity of an X-ray diffraction peak from a (105) plane, and I(006) represents the intensity of an X-ray diffraction peak from a (106) plane.

5. A radially anisotropic, arc segment magnet having an inner diameter of 100 mm or less and made of a rare earth sintered magnet having a main component composition comprising 28–33 weight % of R and 0.8–1.5 weight % of B, the balance being substantially Fe, wherein R is at least one rare earth element including Y, and T is Fe or Fe and Co, said arc segment magnet having an oxygen content of 0.3 weight % or less based on the total weight of the magnet, a density of 7.56 g/cm^3 or more, a coercivity iHc of 1.1 MA/m (14 kOe) or more at room temperature, and an orientation [Br///(Br//+Br⊥)]×100 (%) of 85.5% or more at room temperature, said orientation being defined by a residual magnetic flux density Br// in a radial direction and a residual magnetic flux density Br⊥ in an axial direction perpendicular to said radial direction.

6. The arc segment magnet according to claim 5, wherein it is as thin as 1–4 mm.

7. The arc segment magnet according to claim 5, wherein it is as long as 40–100 mm in an axial direction.

8. A radially anisotropic ring magnet having an inner diameter of 100 mm or less and made of a rare earth sintered magnet having a main component composition comprising 28–33 weight % of R and 0.8–1.5 weight % of B, the balance being substantially Fe, wherein R is at least one rare earth element including Y, and T is Fe or Fe and Co, said ring magnet having an oxygen content of 0.3 weight % or less based on the total weight of the magnet, a density of 7.56 g/cm^3 or more, a coercivity iHc of 1.1 MA/m (14 kOe) or more at room temperature, and an orientation [Br///(Br//+Br⊥)]×100 (%) of 85.5% or more at room temperature, said orientation being defined by a residual magnetic flux density Br// in a radial direction and a residual magnetic flux density Br⊥ in an axial direction perpendicular to the radial direction.

9. The ring magnet according to claim 8, having portions bonded by sintering.

10. A method for producing a rare earth sintered magnet comprising the steps of finely pulverizing an alloy for said rare earth sintered magnet to an average particle size of 1–10 μm in a non-oxidizing atmosphere; introducing the resultant fine powder into a mixture liquid comprising 99.7–99.99 parts by weight of at least one oil selected from the group consisting of a mineral oil, a synthetic oil and a vegetable oil and 0.01–0.3 parts by weight of a nonionic surfactant and/or an anionic surfactant; subjecting the resultant slurry mixture to molding in a magnetic field; and carrying out oil removal, sintering and heat treatment in this order.

11. The method for producing a rare earth sintered magnet according to claim 10, wherein the molding in a magnetic field is compression molding, and the compressed green body preferably has a density distribution of 4.3–4.7 g/cm^3 to provide a rare earth sintered magnet having a main phase composed of an $R_2T_{14}B$ intermetallic compound, wherein R is at least one rare earth element including Y, and T is Fe or Fe and Co.

12. A method for producing a thin arc segment magnet having a thickness of 1–4 mm and made of a rare earth sintered magnet having a main component composition comprising 28–33 weight % of R and 0.8–1.5 weight % of B, the balance being substantially Fe, wherein R is at least one rare earth element including Y, and T is Fe or Fe and Co, said arc segment magnet having an oxygen content of 0.3 weight % or less based on the total weight of the magnet, a density of 7.56 g/cm^3 or more, a coercivity iHc of 1.1 MA/m

(14 kOe) or more at room temperature, and an orientation $Br/4\pi I_{max}$ of 96% or more in an anisotropy-providing direction at room temperature, said method comprising the steps of finely pulverizing an alloy for said rare earth sintered magnet to an average particle size of 1–10 μm in a non-oxidizing atmosphere; introducing the resultant fine powder into a mixture liquid comprising 99.7–99.99 parts by weight of at least one oil selected from the group consisting of a mineral oil, a synthetic oil and a vegetable oil and 0.01–0.3 parts by weight of a nonionic surfactant and/or an anionic surfactant; subjecting the resultant slurry mixture to molding in a magnetic field; and carrying out oil removal, sintering and heat treatment in this order.

13. A method for producing a radially anisotropic, arc segment magnet having an inner diameter of 100 mm or less and made of a rare earth sintered magnet having a main component composition comprising 28–33 weight % of R and 0.8–1.5 weight % of B, the balance being substantially Fe, wherein R is at least one of rare earth elements including Y, and T is Fe or Fe and Co, said arc segment magnet having an oxygen content of 0.3 weight % or less based on the total weight of the magnet, a density of 7.56 g/cm^3 or more, a coercivity iHc of 1.1 MA/m (14 kOe) or more at room temperature, and an orientation [Br///(Br//+Br)]×100 (%) of 85.5% or more at room temperature, said orientation being defined by a residual magnetic flux density Br// in a radial direction and a residual magnetic flux density Br⊥ in an axial direction perpendicular to said radial direction, said method comprising the steps of finely pulverizing an alloy for said rare earth sintered magnet to an average particle size of 1–10 μm in a non-oxidizing atmosphere; introducing the resultant fine powder into a mixture liquid comprising 99.7–99.99 parts by weight of at least one oil selected from the group consisting of a mineral oil, a synthetic oil and a vegetable oil and 0.01–0.3 parts by weight of a nonionic surfactant and/or an anionic surfactant; subjecting the resultant slurry mixture to molding in a magnetic field; and carrying out oil removal, sintering and heat treatment in this order.

14. A method for producing a radially anisotropic ring magnet having an inner diameter of 100 mm or less and made of a rare earth sintered magnet having a main component composition comprising 28–33 weight % of R and 0.8–1.5 weight % of B, the balance being substantially Fe, wherein R is at least one rare earth element including Y, and T is Fe or Fe and Co, said ring magnet having an oxygen content of 0.3 weight % or less based on the total weight of the magnet, a density of 7.56 g/cm^3 or more, a coercivity iHc of 1.1 MA/m (14 kOe) or more at room temperature, and an orientation [Br///(Br//+Br⊥)]×100 (%) of 85.5% or more at room temperature, said orientation being defined by a residual magnetic flux density Br// in a radial direction and a residual magnetic flux density Br⊥ in an axial direction perpendicular to the radial direction, said method comprising the steps of finely pulverizing an alloy for said rare earth sintered magnet to an average particle size of 1–10 μm in a non-oxidizing atmosphere; introducing the resultant fine powder into a mixture liquid comprising 99.7–99.99 parts by weight of at least one oil selected from the group consisting of a mineral oil, a synthetic oil and a vegetable oil and 0.01–0.3 parts by weight of a nonionic surfactant and/or an anionic surfactant; subjecting the resultant slurry mixture to molding in a magnetic field; and carrying out oil removal, sintering and heat treatment in this order.

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